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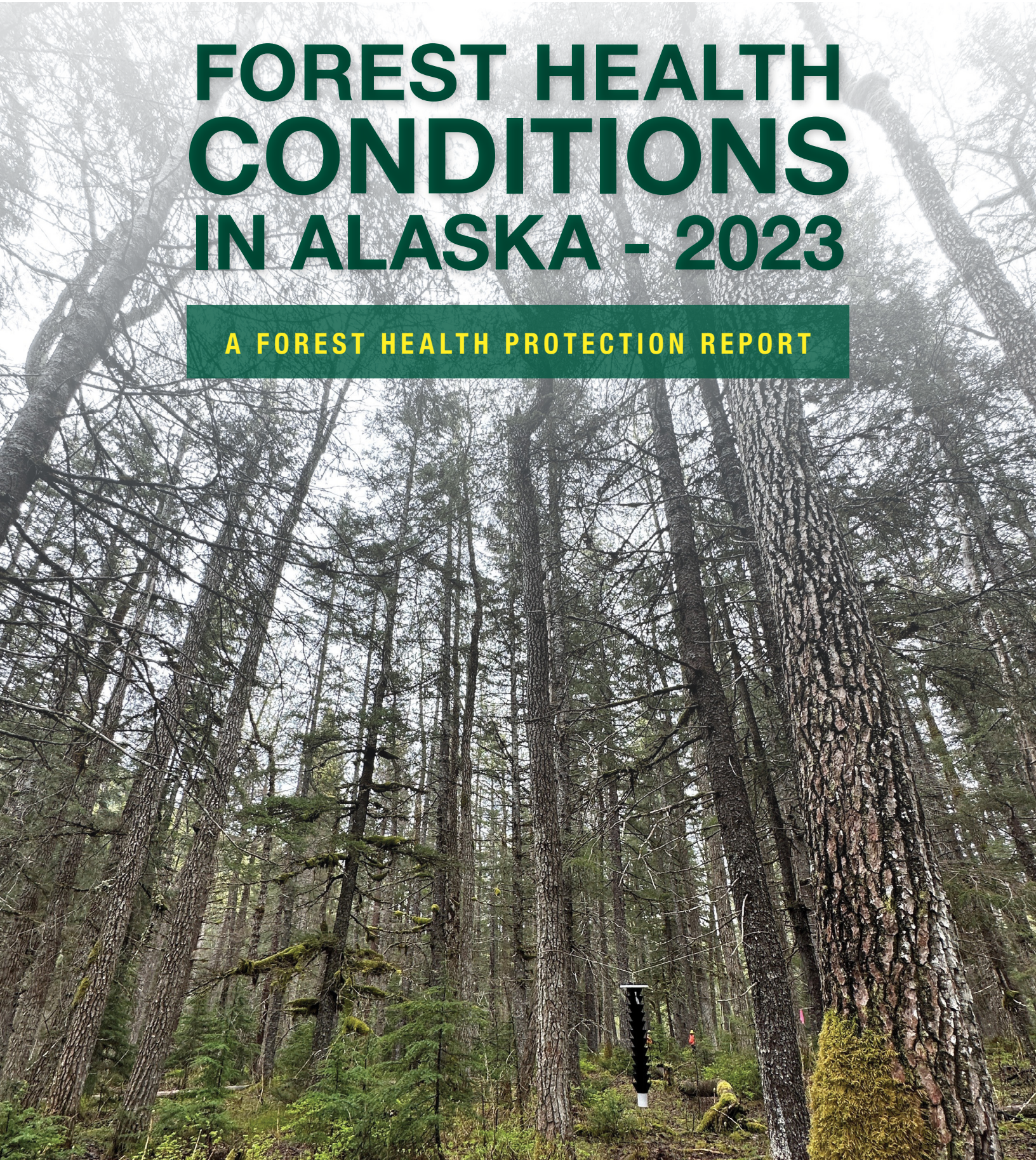
FOREST HEALTH CONDITIONS IN ALASKA - 2023

A FOREST HEALTH PROTECTION REPORT



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Cover Photo | Spruce beetle trapping in Sitka spruce on the Chugach National Forest along Herman Leirer Road, near Seward. USDA photo by Steve Swenson.

FOREST HEALTH CONDITIONS IN ALASKA - 2023

FHP REPORT R10-PR-49

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2023 Highlights

We are proud to announce that the U.S. Forest Service branch containing Forest Health Protection has recently changed its name to State, Private, and Tribal Forestry. Inclusion of the word "Tribal" in the name emphasizes the importance of tribal partnerships in accomplishing forest health and cooperative forestry work across landownerships. Our partner Cooperative Forestry programs have greatly expanded in Alaska since 2020 with new funding opportunities in Wood Innovations, Landowner Assistance, Landscape Scale Restoration, and Urban and Community Forestry. Forest health issues, like insect and disease outbreaks and invasive plant infestations are not restricted by management boundaries, necessitating forest health monitoring, evaluation, and technical assistance across the diverse ecoregions and ownerships of Alaska's forests.

Alaska has 126 million acres of forestland. Nearly 11 million acres are contained within the United States' two largest National Forests, the Chugach (1.1 million acres) and the Tongass (9.8 million acres), while 115 million acres of boreal forest are found outside the National Forest System. Alaska contains one-quarter of all federal forestland and 43 percent of all state-owned forestland in the country. More than 200 Alaska Native Corporations own 35 million acres of non-industrial private forestland.

In 2023, approximately 322,000 acres of forest damage (Table 1) were mapped across the 16.7 million acres aerially surveyed (Table 2). In addition, our forest health team made nearly 2,000 ground observations of forest damage from diseases, insects, and noninfectious agents. Ground detection survey observations of forest insects and pathogens are summarized in Table 4, alongside research grade observations mined from the records of our citizen science project in iNaturalist. The Alaska Forest Health Observations iNaturalist project received about 1,700 research grade observations from over 3,500 total observations in 2023. Organisms that commonly damage trees and plants in Alaska are automatically filtered into the project. Learn more at: https://www.inaturalist.org/projects/alaska-forest-health-observations.

Pathology Highlights

We first discovered the novel disease aspen running canker in 2015 and it has since been documented throughout the boreal forest. In 2020 and 2021, we formally described both the disease and the pathogen. Most infected trees are small diameter trees in the understory and die within a year or two of diagnosis (Fig. 7). In 2023, collaborators Drs. Ursel Schütte and Devin Drown have sequenced and assembled the pathogen's genome and graduate student Jorda Kovash has found potential weaknesses to the pathogen in aspen immune system pathways.

Figure 7. Pathologist Dr. Lori Winton scrapes away the bark of an aspen tree revealing the margin between live and dead tissue killed by aspen running canker. USDA Forest Service photo by Dr. Sydney Brannoch.

We first detected spruce bud blight in Alaska in 2013 and have since discovered that nearly identical symptoms are caused by three different fungi that require specialized equipment to distinguish. The results of studies and statewide surveys in collaboration with Dr. Gerard Adams, Dr. Sydney Everhart, and graduate student Sergio Gabriel-Peralta have revealed that the three fungi are extremely closely related and can cohabit the same buds. This may provide a model system to study niche partitioning and the important ecological principle of competitive exclusion.

Spruce needle rust infection was particularly heavy in Southcentral Alaska this year. We received numerous reports of the disease, sometimes affecting all current-year needles on trees. More than 8,200 acres of damage were mapped during aerial detection surveys conducted before the peak of the outbreak.

TABLE 1. Forest insect and disease activity detected during aerial detection surveys in Alaska in 2023 by land ownership and agent. All values are rounded to the nearest whole acre*.

Category	Agent	Total Acres	National Forest	Native	Other Federal	State & Private
Disease	Alder dieback	**380**	17	2	16	346
Disease	Aspen running canker	**71**	0	4	0	66
Disease	Dothistroma needle blight	**2**	0	0	1	1
Disease	Spruce broom rust	**118**	0	8	9	101
Disease	Spruce needle rust	**8,213**	0	5,191	1,084	1,937
Disease	Western gall rust dieback	**79**	53	2	15	10
Disease	Willow leaf rust	**60**	0	0	0	60
Noninfectious	Fire	**59**	0	0	0	59
Noninfectious	Flooding/high-water	**875**	119	88	41	627
Noninfectious	Hemlock flagging	**33**	1	0	32	0
Noninfectious	Landslide/avalanche	**258**	127	66	55	10
Noninfectious	Porcupine damage	**251**	19	0	0	232
Noninfectious	Snow/ice	**5**	0	0	5	0
Noninfectious	Western redcedar topkill	**0**	0	0	0	0
Noninfectious	Windthrow/blowdown	**1,436**	813	107	0	516
Noninfectious	Yellow-cedar decline	**20,145**	18,985	415	225	520
Insect	Aspen leafminer	**80,569**	0	4,762	490	75,317
Insect	Birch leaf roller	**20**	0	0	5	15
Insect	Hemlock mortality-past year	**28,693**	27,058	667	658	309
Insect	Northern spruce engraver	**124**	0	15	41	69
Insect	Northern spruce engraver/spruce beetle	**755**	13	194	79	470
Insect	Spruce beetle	**90,127**	3,644	6,001	34,713	45,770
Insect	Western balsam bark beetle	**15**	0	1	1	13
Insect	Western blackheaded budworm	**62,987**	32,149	3,981	6,326	20,531
Insect	Willow leafblotch miner	**7,364**	0	1,952	1,213	4,199
General Damage	Alder defoliation	**11,089**	1,291	2,445	62	7,290
General Damage	Aspen defoliation	**4,652**	0	969	6	3,677
General Damage	Birch defoliation	**1,717**	0	178	80	1,458
General Damage	Conifer defoliation	**43**	0	0	0	43
General Damage	Cottonwood defoliation	**1,483**	48	216	351	868
General Damage	Hardwood defoliation	**679**	297	0	237	145
General Damage	Unknown	**10**	6	0	0	4
General Damage	Willow defoliation	**140**	22	1	9	109
General Damage	Willow dieback	**57**	0	2	41	15

*Acre values are only relative to survey transects and do not represent the total possible area affected. Table entries do not include many diseases (e.g., decays and dwarf mistletoe), which are not detectable in aerial surveys.

**General Damage is tree damage that cannot be attributed to a particular agent because more than one agent is known to similarly damage the same host. Either or both insects and pathogens may cause the damage. Damage caused by a currently unidentified agent is also included in this category.

Figure 8. Yellow-cedar shoot blight (*Kabatina thujae*) on yellow-cedar on Annette Island. USDA Forest Service photo by Robin Mulvey.

Figure 9. Yellow-cedar decline has progressed in this managed young-growth stand on Zarembo Island for about a decade, evidenced by dead and dying cedars. USDA Forest Service photo by Robin Mulvey.

Cedar leaf blight of western redcedar was more severe in 2023 than ever previously noted in Southeast Alaska. It is considered an important disease in neighboring British Columbia, but usually causes widespread, low severity disease here. Damage was especially pronounced on Prince of Wales and Zarembo Islands. Warm, wet conditions are conducive to disease development, so this will be an important disease to track under climate change. Another disease that was common across Southeast this year in association with ample rainfall is yellow-cedar shoot blight (Fig. 8). High disease incidence was detected in a common garden planting of yellow-cedar north of Juneau. The common garden trial provides an opportunity to evaluate the heritability of disease susceptibility and tolerance.

Noninfectous Highlights

In 2023, more than 20,000 acres of active yellow-cedar decline were mapped in Southeast Alaska during aerial detection survey, a two-fold increase from last year. Yellow-cedar decline has continued to impact young-growth stands managed for timber. We reassessed monitoring plots in affected stands on Zarembo Island and found a notable increase in mortality and crown symptom incidence (Fig. 9). We continue to track small areas of yellow-cedar mortality on the Outer Coast of Glacier Bay National Park. Yellow-cedar forests in this area have previously been considered unaffected by decline mortality; however, decline impacts are anticipated in this part of the range based on models that incorporate the risk factors of yellow-cedar decline, hydrology and snowpack, under climate change.

Western redcedar topkill on Prince of Wales Island is associated with girdling stem wounds caused by mammal feeding activity. Wound samples from 15 western redcedar trees were processed to determine the seasonality and year of injury. Damage occurred early in the growing season and individual trees were often wounded across multiple years. Woody tissue samples were collected for eDNA identification of the culprit, the results of which are expected in 2024. The current hypothesis is that northern flying squirrels are causing the injuries. Distinct from the girdling stem wound injury to western redcedar, we also noted crown die-back and progressive topkill on Prince of Wales and Revillagigedo Islands. This damage is thought to be associated with drought conditions in 2018 and 2019.

We have begun to rely on the LandTrendr RGB Pixel Time Series tool in Google Earth Engine (GEE) to validate the timing of landslide and wind events mapped during aerial detection surveys. This tool, developed by the Kennedy Lab at Oregon State University, accesses Landsat imagery from 1984 to 2023 in GEE and compares spectral values across years to detect when a change occurs. This approach enabled us to determine that wind damage near Haines occurred in 2023, and wind damage on Admiralty Island occurred in 2021 or just prior.

Invasive Plant Highlights

The state of Alaska is fortunate to have dedicated Soil and Water Conservation Districts (SWCDs) and non-governmental organizations working to control the introduction and spread of terrestrial invasive plant species alongside federal land managers. A funding infusion from the Bipartisan Infrastructure Bill has increased both the number and reach of invasive plant management activities in Alaska. The Homer SWCD took the lead and administered a State, Private, and Tribal Forestry grant to increase the capacity of SWCDs to conduct Weed-Free inspections along with other prevention and Early Detection Rapid Response activities across the state. The Southeast Alaska Watershed Coalition hired an Invasive Species Coordinator for Southeast Alaska, who is working to bring together island communities and build invasive plant management programs. The Anchorage SWCD reinstated its invasive species program in 2022 and completed an impressive amount of fieldwork in 2023 in a major point of entry for aquatic and terrestrial invasive species in the state.

TABLE 2. Mapped affected area (in thousands of acres) from 2019 to 2023 from aerial detection survey.

Damage Category *	2019	2020	2020**	2022	2023
Abiotic damage	10.8	0.2	16.7	3.4	2.6
Alder defoliation	2.6	1.0	3.1	12.7	11.1
Alder dieback	1.2	0.0	0.1	1.0	0.4
Aspen defoliation	132.4	38.8	150.5	39	85.2
Aspen mortality	0.1	0.0	0.1	0.1	0.1
Birch defoliation	283.4	3.9	55.6	22.6	1.7
Cottonwood defoliation	1.7	0.7	0.7	0.7	1.5
Fir mortality	0.1	0.0	0.1	0.0	0.0
Hardwood defoliation	3.9	0.1	0.4	1.0	0.7
Hemlock defoliation	381	124.4	520.0	1.3	0.0
Hemlock mortality	0.0	80.0	21.0	73.5	28.7
Larch mortality	0.0	0.0	0.0	0.0	0.0
Porcupine damage	1.9	0.1	0.2	0.0	0.3
Shore pine damage	0.4	0.0	0.5	0.6	0.1
Spruce damage	117.8	0.7	7.6	4.2	8.3
Spruce mortality	140.6	145.3	193.7	49.6	91.0
Spruce/hemlock defoliation	0.0	0.0	0.0	685.8	62.9
Willow defoliation	32.7	0.5	58.3	17.0	7.6
Willow dieback	0.6	0.0	0.0	0.0	0.1
Yellow-cedar decline	20.0	10.4	8.2	11.7	20.2
Total damage acres * **	**1127.6**	**309.0**	**1019.7**	**874.8**	**322.5**
Total acres surveyed	22,421	7,322	15,724	16,314	16,731
Percent of acres surveyed showing damage	4.6%	4.2%	6.5%	5.4%	1.9%

*Agents specific to each category are listed in Table 3 on page 8.

** In 2020, aerial detection surveys were not conducted. Data was collected via high-resolution satellite imagery for a limited area.

*** Total damage acres do not double count overlapping damage areas, do not include older spruce damage collected in the current year, and may include minor damage not reported above.

The Alaska Exotic Plant Information Clearinghouse (AKEPIC) is the repository for invasive inventory data across land ownerships in Alaska. When assessing the spread of "extremely" or "highly" invasive plants within the state over the past ten years, there are two plant species of note:

1. **Orange hawkweed** is spreading westward down the Alaska Peninsula and the Aleutian Islands, as well as into more remote areas near Southeast communities and Anchorage. These locations have ample habitat preferred by orange hawkweed: full sun and nutrient poor, well-drained soil.
    a. Alaska Peninsula: First documented in 2015 on the western edge of the Alaska Peninsula in Cold Bay, six new locations were reported in 2021 and 2022.
    b. Aleutian Islands: Several infestations have been reported on the Aleutian Islands, including Chignik in 2023, Unalaska Island in 2021, and Adak Island in 2017.
    c. Anchorage SWCD has found orange hawkweed moving into subalpine habitat adjacent to Chugach State Park.
    d. Skagway: Orange hawkweed was first documented by the Skagway Traditional Council in 2015 as well as 1.25 miles up the Denver Valley Trail.
    e. Misty Fjords Wilderness Area had its first documented infestations of orange hawkweed at two locations associated with the Quartz Hill Mine.
2. **European bird cherry and chokecherry** now occur farther afield. Until recently, this tree has been considered an 'urban invasive,' but this is no longer the case. The Anchorage SWCD surveys found more Prunus in Chugach State Park than anticipated in 2023. Community members reported occurrences along lake shores accessed only by float plane, as well as far from other known infestations alongside the Kennicott Glacier, at Naknek, and in Galena. This tree is an aggressive colonizer of riparian and forested wetland communities, outcompeting the understory shrub and forb plants. The ecological concern associated with European bird cherry and chokecherry include the changes in plant community richness and structure, as well as the potential effects upon moose and changes in the riparian food web.

Insect Highlights

The western blackheaded budworm outbreak subsided throughout most of Southeast Alaska. Caterpillars were found during ground surveys, however damage associated with their feeding was minimal (Fig. 10). Light western blackheaded budworm defoliation was recorded during aerial detection surveys in Hoonah, Excursion Inlet, and from Holkham Bay to Skagway, totaling 63,000 acres. Hemlock sawfly damage was not observed during the 2023 aerial detection survey. Hemlock mortality from past defoliation was minimal in most areas, but dense in some pockets on Admiralty and Chichagof Islands and along Excursion Inlet, totaling 28,700 acres. Areas previously impacted were dominated by top-killed trees with some trees showing needle regeneration that cast a subtle green shade to gray trees.

Figure 10. Light damage from western blackheaded budworm feeding. Caterpillars partially feed on new hemlock needles causing the tips to turn red. Previous feeding damage is evident in the top part of the crown. USDA Forest Service photo by Dr. Elizabeth Graham.

Spruce beetle activity was recorded on just over 90,000 acres during aerial detection surveys in 2023. To date, the outbreak has impacted approximately 2.17 million cumulative acres of forests. The outbreak remains most active between Cantwell and Healy in the Denali Borough, on the east side of the Talkeetna Mountains in the northern Matanuska-Susitna Borough, in and around the Chugach National Forest, and between Skilak Lake and Tustumena Lake on the Kenai Peninsula.

Aspen and birch leafminer continue to be the most damaging agents in the Interior. Ground detection surveys confirmed heavy defoliation caused by late birch leaf edgeminer and amber-marked birch leafminer. Aspen leafminer damage was detected along every major roadway in and out of Fairbanks, with damage tapering in severity towards the Brooks Range, the Alaska Range, and the Canadian border.

Table 3. Damage Type by Category*

ABIOTIC
Drought
Flooding
Landslide/avalanche
Windthrow
Winter damage

ALDER DEFOLIATION
Alder defoliation
Alder leafroller
Alder sawfly

ALDER DIEBACK
Alder dieback

ASPEN DEFOLIATION
Aspen defoliation
Aspen leaf blight
Aspen leafminer
Large aspen tortrix

ASPEN MORTALITY
Aspen running canker

BIRCH DEFOLIATION
Birch aphid
Birch crown thinning
Birch defoliation
Birch leafminer
Birch leafroller
Dwarf birch defoliation
Spear-marked black moth

COTTONWOOD DEFOLIATION
Cottonwood defoliation
Cottonwood leaf beetle
Cottonwood leafminer
Cottonwood leafroller

FIR MORTALITY
Western balsam bark beetle

HARDWOOD DEFOLIATION
Hardwood defoliation
Rusty Tussock Moth
Speckled green fruitworm

HEMLOCK DEFOLIATION
Hemlock flagging
Hemlock looper
Hemlock sawfly
Western blackheaded budworm

HEMLOCK MORTALITY
Hemlock canker
Hemlock mortality
Hemlock defoliation

LARCH DEFOLIATION
Larch budmoth
Larch discoloration
Larch sawfly

LARCH MORTALITY
Larch beetle

SHORE PINE DAMAGE
Dothistroma needle blight
Shore pine dieback
Western gall rust

SPRUCE DAMAGE
Spruce aphid
Spruce broom rust
Spruce bud moth
Spruce budworm
Spruce defoliation
Spruce needle cast
Spruce needle rust

SPRUCE MORTALITY
Northern spruce engraver
Spruce beetle

SPRUCE/HEMLOCK DEFOLIATION
Western blackheaded budworm
Conifer defoliation

WILLOW DEFOLIATION
Willow defoliation
Willow leafblotch miner
Willow rust

WILLOW DIEBACK
Willow dieback

YELLOW-CEDAR DECLINE
Yellow-cedar decline

* Other than porcupine, animal-caused damages are not listed as stand-alone categories; when notable, they are listed under the host species they have affected.

TABLE 4. Select ground observations of forest insects and pathogens in Alaska in 2023. Ground survey protocols are described in Appendix II on page 73. Ground observations by citizen scientists can be found in The Alaska Forest Health Observations project on iNaturalist, accessed at https://www.inaturalist.org/projects/alaska-forest-health-observations. Observations of unidentified or noninfectious agents from our ground surveys and species not closely tied to forest health are excluded.

Damage Agent Category	Damage Causing Agent	Scientific Names	Ground Observations[1]	iNaturalist Research Grade Observations[2]	Total
Insects	Adelgidae	Adelgidae spp.	26	0	26
Insects	Alder woolly sawfly	*Eriocampa ovata*	4	5	9
Insects	Amber-marked birch leafminer	*Profenusa thomsoni*	26	5	31
Insects	Aspen leafminer	*Phyllocnistis populiella*	85	45	130
Insects	Birch aphid	*Euceraphis betulae*	13	0	13
Insects	Birch leafminer/roller	*Caloptilia* spp.	79	0	79
Insects	Birch leafroller	*Epinotia solandriana*	6	0	6
Insects	Cottonwood leaf beetle	*Chrysomela scripta*	6	0	6
Insects	Eriophyid mite	Eriophyidae spp.	165	22	187
Insects	Gall/Adelgidae spp.	Gall/Adelgidae spp.	24	0	24
Insects	Gall midge	Cecidomyiidae spp.	49	6	55
Insects	Green alder sawfly	*Monsoma pulveratum*	10	6	16
Insects	Hemlock sawfly	*Neodiprion tsugae*	24	0	24
Insects	Late birch leaf edgeminer	*Heterarthrus nemoratus*	32	6	38
Insects	Leaf beetles spp.	Leaf beetles spp.	2	7	9
Insects	Leafminers spp.	Leafminer spp.	84	0	84
Insects	Rusty tussock moth	*Orgyia antiqua*	1	29	30
Insects	Sparkling Archaic Sun Moths	Eriocraniidae spp.	0	26	26
Insects	Spotted tussock moth	*Lophocampa maculata*	3	60	63
Insects	Spruce beetle	*Dendroctonus rufipennis*	14	4	18
Insects	Spruce bud moth	*Zeiraphera canadensis*	16	0	16
Insects	Spruce budworm	*Choristoneura* spp.	13	0	13
Insects	Striped alder sawfly	*Hemichroa crocea*	3	1	4
Insects	Western blackheaded budworm	*Acleris gloverana*	55	21	76

[1] Ground detection survey observations are made by Forest Health Protection professionals in the field via direct observation.

[2] iNaturalist Research Grade Observations are reported by citizen scientists on iNaturalist that are identified to species or genus and have two-thirds community agreement on the taxonomic identification. Species-level identifications are typically, but not always, needed to establish research-grade status.

TABLE 4. Select ground observations of forest insects and pathogens in Alaska in 2023. Ground survey protocols are described in Appendix II on page 73. Ground observations by citizen scientists can be found in The Alaska Forest Health Observations project on iNaturalist, accessed at https://www.inaturalist.org/projects/alaska-forest-health-observations. Observations of unidentified or noninfectious agents from our ground surveys and species not closely tied to forest health are excluded.

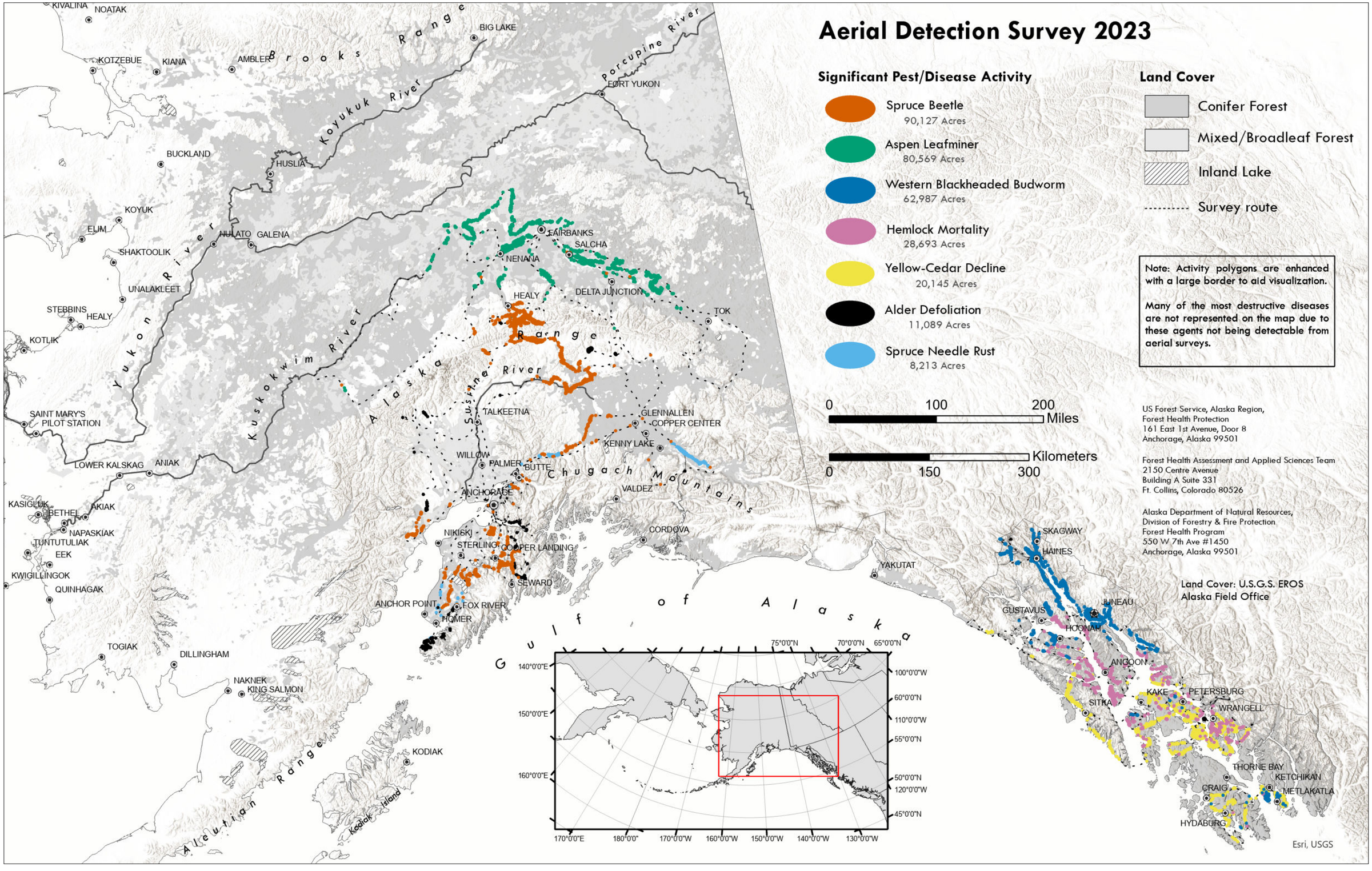
Damage Agent Category	Damage Causing Agent	Scientific Names	Ground Observations[1]	iNaturalist Research Grade Observations[2]	Total
Insects	Western tent caterpillar	*Malacosoma californicum*	0	1	1
Insects	Willow leafblotch miner	*Micrurapteryx salicifoliella*	58	9	67
Insects	Yellowheaded spruce sawfly	*Pikonema alaskensis*	7	0	7
Pathogens	Alder canker dieback	*Valsa melanodiscus* and *Valsalnicola* spp.	11	0	11
Pathogens	Armillaria root disease	*Armillaria* spp.	6	2	8
Pathogens	Artist's conk	*Ganoderma applanatum*	13	27	40
Pathogens	Aspen running canker	*Neodothiora populina*	20	0	20
Pathogens	Aspen shoot blight	*Venturia macularis*	5	0	5
Pathogens	Bear's head fungus	*Herricium abietis*	2	16	18
Pathogens	Birch polypore	*Fomitopsis betulina*	11	49	60
Pathogens	Brown crumbly rot	*Fomitopsis mounceae*[3]	17	91	108
Pathogens	Brown crumbly rot	*Fomitopsis ochracea*[3]	40	121	161
Pathogens	Brown crumbly rot	*Fomitopsis pinicola* sensu lato[3]	18	4	22
Pathogens	Brown cubical butt rot	*Phaeolus schweinitzii*	9	28	37
Pathogens	Canker-rot of birch/chaga	*Inonotus obliquus*	4	14	18
Pathogens	Cedar leaf blight	*Didymascella thujina*	30	0	30
Pathogens	Coral tooth fungus	*Hericium coralloides*	0	34	34
Pathogens	Diplodia gall	*Diplodia tumefaciens*	5	2	7
Pathogens	Dothistroma needle blight	*Dothistroma septosporum*	14	3	17
Pathogens	Hardwood leaf rusts	*Melamspora* and *Melampsoridium* spp.	47	14	61
Pathogens	Hartig's conk	*Phellinus hartigii*	4	1	5
Pathogens	Hemlock dwarf mistletoe	*Arceuthobium tsugense*	30	8	38
Pathogens	Hemlock-blueberry rust	*Naohidemyces vaccinii*	29	1	30

[3] *Fomitopsis pinicola* sensu lato is a species complex that contains *F. mounceae* and *F. ochraceae*. Some identifications must remain at the species complex when identifying characteristics are absent.

TABLE 4. Select ground observations of forest insects and pathogens in Alaska in 2023. Ground survey protocols are described in Appendix II on page 73. Ground observations by citizen scientists can be found in The Alaska Forest Health Observations project on iNaturalist, accessed at https://www.inaturalist.org/projects/alaska-forest-health-observations. Observations of unidentified or noninfectious agents from our ground surveys and species not closely tied to forest health are excluded.

Damage Agent Category	Damage Causing Agent	Scientific Names	Ground Observations[1]	iNaturalist Research Grade Observations[2]	Total
Pathogens	Lacquer/varnish conk	*Ganoderma oregonense* or *G. tsugae*	0	10	10
Pathogens	Lirula needle cast	*Lirula macrospora*	13	0	13
Pathogens	Lophodermium needle cast	*Lophodermium piceae*	1	0	1
Pathogens	Paint fungus	*Echinodontium tinctorium*	2	0	2
Pathogens	Quinine conk	*Laricifomes officinalis*	2	2	4
Pathogens	Red ring rot	*Porodaedalea pini*	29	24	53
Pathogens	Rhizosphaera needle cast	*Rhizosphaera* spp.	13	0	13
Pathogens	Sirococcus shoot blight	*Sirococcus tsugae*	2	0	2
Pathogens	Spruce broom rust	*Chrysomyxa arctostaphyli*	51	26	77
Pathogens	Spruce bud blights	Spruce bud blights	49	0	49
Pathogens	Spruce bud rust	*Chrysomyxa woroninii*	5	2	7
Pathogens	Spruce cone rusts	*Chrysomyxa pirolata* and *Rossmanomyces monesis*	30	6	36
Pathogens	Spring spruce needle rust	*Ceropsora weirii (=Chrysomyxa weirii)*	12	0	12
Pathogens	Spruce needle rust	*Chrysomyxa ledicola*	73	18	91
Pathogens	Sulfur fungus	*Laetiporus conifericola*	8	86	94
Pathogens	Tinder conk/hoof fungus	*Fomes fomentarius*	31	69	100
Pathogens	Tomentosus root rot	*Onnia tomentosa*	9	25	34
Pathogens	Trunk rot of aspen	*Phellinus tremulae*	16	1	17
Pathogens	Trunk rot of birch	*Phellinus igniarius* sensu lato	59	20	79
Pathogens	Viburnum leaf and stem rust	*Puccinia linkii*	1	11	12
Pathogens	Western gall rust	*Cronartium harknessii*	19	7	26
Pathogens	Yellow-cedar shoot blight	*Kabatina thujae*	17	0	17

Map 1. 2023 Aerial Detection Survey. For more information on survey methods in 2023, please see Appendix 1, page 65.



Map 2. 2023 Aerial Detection Survey flight paths. For more information on survey methods in 2023, please see Appendix 1, page 65.